which is not soluble in water (or at least not in the quantity of water from which it was extracted).

It therefore appears probable that the effect of toluene on the soil is to render insoluble and innocuous this toxic substance. Similarly with the other antiseptics mentioned; ether apparently does not convert the substance into an insoluble form, and its method of acting is being investigated.

The writer has also found that heating to dryness on a water-bath decomposes this substance, and it is probable when in the soil that a lower temperature will suffice. It seems probable, therefore, that the fertilising effect of sunlight will be found to be due to the decomposition of this toxic substance.

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TRANSCASPIAN ARCHÆOLOGY.[1]

IN the two volumes referred to below are incorporated the results of the American expedition which visited Russian Turkestan under the direction of Mr. Raphael Pumpelly, the well-known geologist, in 1904, and, besides conducting excavations at Anau, near Askhabad, collected material bearing on the physiography of the Central Asian deserts and oases. Thus the work of the expedition was two-fold. On one hand, we are presented with geological and physiographical observations, illustrating changes which have taken place in the character of Central Asia; on the other, we have a full and able presentment of the archæological material obtained from the excavations at Anau, including a very complete ceramic record. We should add that the excavations were directed by Dr. Hubert Schmidt, of Berlin, who joined the staff of the expedition for that purpose.

On the physical side, Mr. Pumpelly, assisted by Messrs. Davis, Huntington, and R. W. Pumpelly, who were also members of the expedition, found traces in High Asia of several great glacial expansions during the Glacial period. According to the picture which he gives us, there existed a cap of continental ice, thousands of feet thick, which spread over nearly the whole of European Russia; and Central Asia was covered by a huge inland sea, larger than the Mediterranean, and fed by rivers flowing from the snow and ice. The sub-Glacial period was marked by a general trend towards desolation, accompanied by the disappearance of the ice-cap from Russia and a diminution of the great glaciers on the southern mountains. As evaporation became more rapid than the inflow of water, the inland sea shrunk and broke up into smaller basins, and the dried silts of seas and rivers were carried by the wind in great columns of dust across the earth. The lightest material was carried farthest, and deposited in beds of loess, the extraordinarily fine and fertile soil which covers a great part of the surface of Northern China and Turkestan, and extends in a continuous zone from north of the Caspian to Austria. The heavier silts, in the form of sands, moved more slowly along the surface of the plains, where they formed great seas of sand-dunes, heaped up in places to a height of more than a hundred feet. We may note that to the shifting of such sand-deserts in historic times we owe the burial of cities in the Khotan region, which have been so successfully excavated by Dr. Stein for the Indian Government. With regard to the geological side of his work, we certainly think that Mr. Pumpelly's researches on the spot tend to confirm Richthofen's theory of the wind-borne origin of loess, and he has succeeded in obtaining further evidence of his own modification of the theory as to the important part played by river silts, and the chemical action of vegetation, in furnishing the constituents of loess.

As a deduction from his archæological researches, Mr. Pumpelly would regard the Central Asian oases as the fountain-head of Western Asiatic culture. According to his theory, their inhabitants were isolated from Africa and Europe from the Glacial period onward, and their cultural requirements were consequently evolved in complete independence. Changes in climatic conditions, however, took place, under which the early civilisations in these regions tended to disappear, and these gave rise to extensive migrations, which eventually reacted on the outside world. In support of his theory, Mr. Pumpelly would trace the early appearance of wheat and barley in Babylonia and Egypt, and the presence of certain breeds of domestic animals, to their first establishment in the Transcaspian oases. Moreover, he would place the original home of the Sumerians in Central Asia, where, before their arrival in Babylonia and their subsequent fusion with Semitic nomads, he pictures them as having already acquired the elements of their racial culture and organisation under the stern discipline of a struggle with nature. The absence of any form of writing in the mounds of Anau may be cited as negative evidence against any racial, or even cultural, connection with the Sumerians, though, as we shall see later, a study of the ceramic points to some influence having been exerted from that quarter on the early cultures of Susa in Elam.

In this connection it is indeed a moot point whether the parent civilisation was not that of Elam herself.

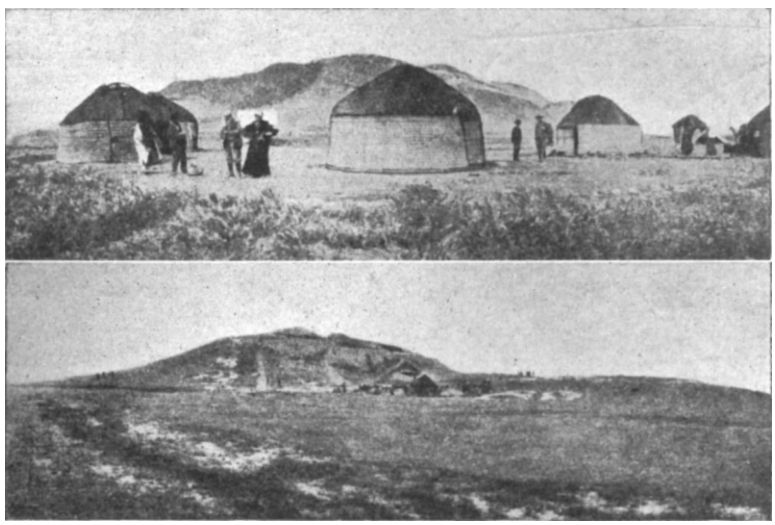

FIG. 1.—(1) The North Kurgan at Anau, in Russian Turkestan, with the Camp of the Pumpelly Expedition in the foreground. (2) The South Kurgan at Anau, showing excavations in progress.

[1] Explorations in Turkestan: Expedition of 1904. Prehistoric Civilisations of Anau. Origins, Growth, and Influence of Environment. Edited by Raphael Pumpelly. Vol. i., pp. xxxvi+240+vi; vol. ii., pp. x+(241-494)+x; with 97 plates and 548 illustrations, including maps and plans. (Washington: Carnegie Institution, 1908.)

It would be tempting to seek the origins of the Babylonian and Elamite cultures in the highlands of Asia, for it is not difficult to assign causes for a succession of migrations westward. The nomad population of Central Asia, swollen to the limit of the supporting capacity of its pasture lands, would be forced to seek outlets into more favoured regions. This process may well have been accelerated by periods of drought, due to the climatic changes which have left no uncertain traces behind them in the character of the country itself. The present condition of aridity would appear to have been of continual growth, with certain oscillations, since the Glacial period. Already in prehistoric times the seas of sand-dunes had en-

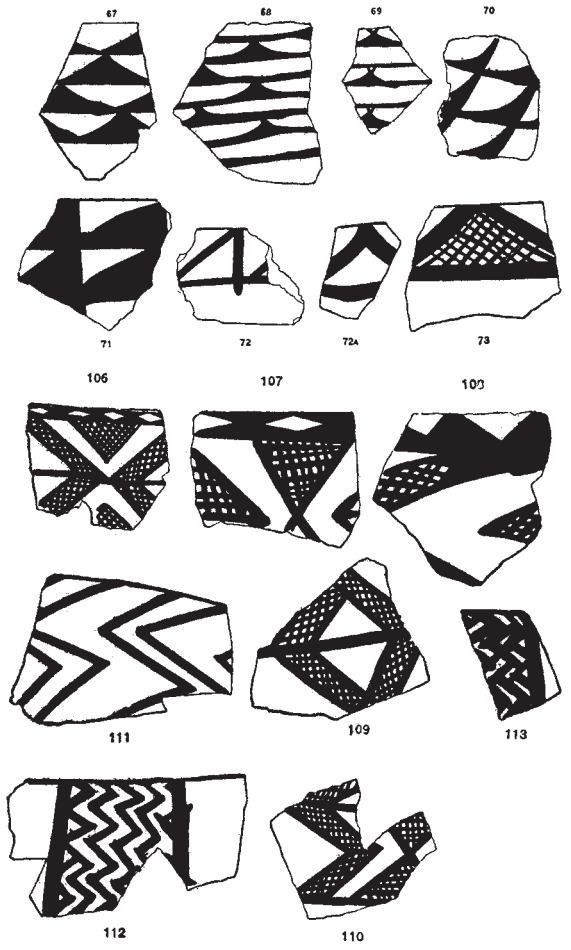

FIG. 2.—Designs on painted potsherds from the Neolithic and Aeneolithic Strata (Cultures I. and II.) at Anau, which bear a certain resemblance to linear and geometric designs on sherds from Elam and Western Asia. From the North Kurgan.

croached upon the fertile plains of loess, and the delta-oases, at the mouths of streams emerging from the mountains, or at points where larger rivers lost themselves on the surface of the plains, have been the favourite home of man. It was at one of these, at Anau, near Askhabad, some three hundred miles east of the Caspian, that the Pumpelly expedition conducted excavations in 1904, and obtained its principal material for archæological study.

Near the middle of the Anau oasis, and about a mile from one another, are the two Kurgans, hills with rounded contours, rising some forty and fifty feet above the plain, and marking the sites of long-forgotten cities. The structure of the North Kurgan had already been exposed by a trench cut in it some twenty-five years ago by General Komorof, which showed a series of stratified remains, including the bones of animals and potsherds of plain and painted ware. It was this trench which first directed Mr. Pumpelly's attention to the mound, and his subsequent excavations, both here and in the South Kurgan, laid bare a stratified structure of precisely similar character. The strata represented successive occupations of the sites, and, as their inhabitants lived in houses built of sun-dried brick, the hills gradually rose in height by the accumulation of *débris* from previous settlements. Of the two hills, the North Kurgan was of earliest formation, its earlier strata representing a Stone-age culture, while its upper layers belong to an æneolithic stage of civilisation. The third culture, that of the South Kurgan, dates from a Copper age. The archæological part of the work was left wholly to Dr. Schmidt, assisted by Miss Brooks, and to his admirable method of noting the precise spot and level of every object recovered we owe the possibility of tracing the gradual development of culture during the successive periods of settlement. Moreover, the Transcaspian Railway passes little more than half a mile to the north of the North Kurgan, so that no difficulty and little risk were involved in the conveyance to Europe of all the archæological material obtained. The collection of animal bones from the North Kurgan alone weighed nearly half a ton, but the neighbourhood of the railway enabled the whole collection to be transported without trouble to Dr. Duerst, of Zürich, who contributes a report on them as part vi. in the second volume.

The cultural progress of the three great periods is most clearly revealed by the pottery, which exhibits a gradual evolution in form, technique, and decoration. Although the vessels of the first two cultures are hand-made, and the wheel was not introduced until the advent of the Copper age, yet the vessels of both earlier epochs are excellent ceramic productions. It would be out of place in the present review to discuss in detail the problems presented by a study of the potsherds, so admirably edited by Dr. Schmidt; but it may be noted that many of the geometric designs occurring on pottery of the earlier periods from North Kurgan bear a striking resemblance to designs on pottery found by MM. Gautier and Lampre at Mussian, and by M. de Morgan at Susa. This may well point to some connection between the stone and early metal-using cultures of Transcaspia and Elam, while the baked clay figurines from the copper culture of South Kurgan may be due to some early cultural contact with Babylonia, as first suggested by Prof. Sayce. Whether we may treat as significant a further resemblance which has recently been pointed out by Mr. H. R. Hall between the Persian and Transcaspian sherds, on the one side, and fragments of similar geometric pottery on sites in Asia Minor and even in Northern Greece, is a subject outside the scope of the present review. That such problems should be even mooted is a sufficient testimony to the importance of the archæological material obtained by the Pumpelly expedition.

In fact, Mr. Pumpelly, though not an archæologist himself, has, with Dr. Schmidt's valuable cooperation, produced a work of the first importance to students of archæology. In the first five chapters of part i. of the first volume he has admirably summarised the results obtained by the expedition, but there is one feature of his treatment to which we feel we

must take exception. Mr. Pumpelly's attitude with regard to prehistoric chronology is indicated by the remark with which he introduces his description of the sub-Glacial period in Central Asia. "Remember," he says, "that while we look, in our time-perspective, millenniums are as seconds." This generous and imaginative method of treating the lapse of time, which is no doubt a very necessary virtue in the geologist, is wholly destructive of an accurate chronology in archæological study. Moreover, the attempt to apply geological methods of dating to the purely artificial growth of a city site is totally unscientific, and we are glad to note from a remark at the end of Mr. Pumpelly's preface that he has already realised the possibility of error in at least one of his assumptions. Such dates as 8000 B.C., which he suggests for the beginning of the Neolithic settlement at North Kurgan, or 5000 B.C., for the beginning of the Copper age in South Kurgan, are wholly fanciful. It is true that very early dates were at one time in vogue, both in Egyptian and more particularly in Babylonian archæology; but these are now given up, and it is recognised that the earliest Sumerian remains in Babylonia do not date from an earlier period than the end of the fourth millennium B.C., while the Neolithic remains at Susa are probably not of a very much earlier period. While these facts naturally affect the dates suggested by Mr. Pumpelly for the cultures at Anau, they do not in any way upset their relative arrangement. It is perhaps significant that Dr. Schmidt nowhere mentions a date; and throughout the whole work the material is presented in such a way that the student is in no way hampered or misled.

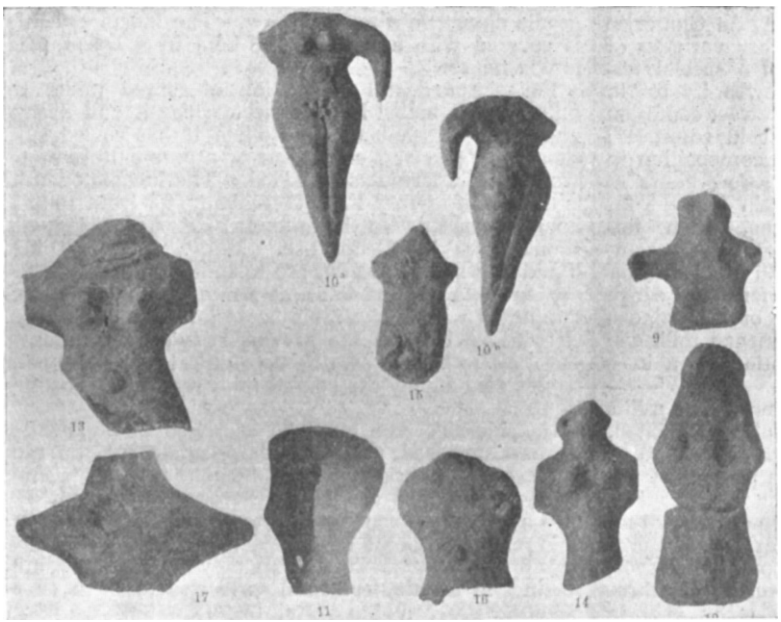

FIG. 3.—Terracotta figurines from the Copper Age Stratum (Culture III.) at Anau, suggesting a cultural connection with Babylonia. From the South Kurgan.

The success of the expedition, and the admirable volumes which set forth its achievements and results, are a striking testimony to Mr. Pumpelly's enthusiasm and powers of organisation, and at the same time show the high scientific aims and standards which inspire American archæological and geological research at the present time. L. W. KING.

SOURED MILK: ITS NATURE, PREPARATION, AND USES.

THERE seems to be little doubt that as age advances the microbial flora of the human intestine, especially of the lower portion or large intestine, often undergoes a change both in the number and in the character of the micro-organisms present. From middle life onwards the number of microbes increases, and species capable of inducing putrefactive decomposition of proteins become more abundant. This change can be roughly gauged by making microscopical preparations of the dejecta and staining by the Gram process, a selective method by which certain organisms only are stained. In the child's dejecta Gram-staining microbes are relatively scanty and are mostly *Bacillus bifidus and B. acidophilus,* and it is noteworthy that these are lactic-acid producing bacilli. In and after middle life Gram-staining forms usually become more and more numerous, the Gram-staining species now being principally *Bacillus putrificus* and *B. Welchii,* bacteria which induce marked putrefactive decomposition of proteins.[1] In unhealthy conditions of the intestinal tract somewhat similar changes or various abnormal fermentations may occur.

Metchnikoff[2] in a study of the nature of senility formulated the hypothesis that it is caused, partially at least, by auto-intoxication, poisoning by the absorption of products derived from the action of micro-organisms in the digestive tract. Such poisons would be the products of the putrefactive decompositions brought about by the micro-organisms named, and also bodies belonging to the phenol series which are formed by the action of *Bacillus coli,* which is always present in the intestines, becomes more and more numerous from youth to old age, and which also multiplies excessively in unhealthy conditions of the digestive tract. In seeking for some agent which would combat the multiplication of micro-organisms in the intestine, particularly these harmful forms, Metchnikoff conceived that lactic acid, which has no deleterious action in the human economy, would probably effect the end desired, since the growth of these bacteria is inhibited by a moderate percentage of this acid. Bienstock, for example, found that the B. *putrificus* is inhibited in growth by *B. coli* thanks to its acid-producing power, the acid formed, though small in amount, being lactic acid. Simply to introduce the acid as such would, however, be of little use, for it would be absorbed and decomposed long before it reached the large intestine. Metchnikoff therefore sought for some means whereby lactic acid might be formed *in situ,* and naturally fell back on the use of lactic-acid-producing bacteria, which, if they could be established in the large intestine, might there produce sufficient lactic acid to inhibit the growth of the putrefactive and other deleterious forms. But the problem was not an easy one, for it entailed the finding of a lactic acid ferment which would grow at body tem-

1 Herter, "Bacterial Infections of the Digestive Tract," 1907.
2 "On the Prolongation of Human Life."